YELLOW LEAF DISEASE OF ARECA PALMS

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The disease was first reported from Muvattupuzha, Meenachil and Chalakudi areas of Central Kerala in 1949. It is known as 'Kattuvizhcha' and 'Chandiroga' in Malayalam and Kannada respectively. The disease incidence was as high as 90% in Quilon district of Kerala in 1960's itself. The disease is also reported from central parts of Maharashtra and Tamilnadu. A survey conducted in 1976 in 210 disease affected villages in Kerala and Karnataka revealed that 35.8% out of the 92.6% of areca growing area was affected in Kerala and 24.4% in Karnataka. A survey conducted in 1987 revealed widespread occurrence of the disease in Sullia and certain pockets of Puttur in Dakshina Kannada. A statewide survey conducted in 1989-90 showed that the disease is present in malnad districts of Karnataka also. Reduction in yield up to 50% and leaf fall up to 4% was recorded over a short span of three years following the disease (Anon., 1977). Organised research on yellow leaf disease (YLD) started in 1959 at Regional Arecanut Research Station, Palode and Central Arecanut Research Station, Vittal (Rawther, 1982).

Symptoms

First visible symptom is yellowing at the tips of leaflets in two or three leaves of the outermost whorl. This yellowing is entirely different from other types of yellowing due to nitrogen deficiency, drought, water logging, mite and root grub infestation and 'anabe' disease. There is a clear-cut demarcation of yellow and green regions. There will be a clear band of green tissue adjacent to the midrib areas of the leaf as well as the leaflets. In the early stages of the disease, the symptoms begin disappearing well before the 'onset'of the dry season and remain symptomless during the dry season (December to May). There is heavy shedding of both mature and immature nuts (Nambiar 1949). Blackish brown discoloration of endosperm, which is soft to touch, may occur in some cases. The discolored nuts are not good for chewing. In the advanced stages the leaves become short, stiff, pointed, closely bunched and abnormally puckered. The leaf tips become necrotic and dry up during summer. In severe cases the crown of palm falls off (Nayar and Seliskar, 1978). Root system also exhibits varying degrees of rotting and also reduction in lateral root production. Accumulation of starch in the medullary rays, anatomical changes such as multinucleate cells, derranged tissues, blocking of palisade tissues with dark brown pigments in the leaf and excessive phloem degeneration of the affected stem and leaf tissues are also recorded. Besides, degeneration of the cortex and presence of tyloses in the xylem vessels of the diseased roots are also observed.

Etiology

First report of the association of an organism with YLD was by Khandige *et al.*, (1957). He observed mites on the affected leaves. Later Menon (1960) concluded that mites were not responsible for the disease.

Fungi : More than fifty four fungi (Anon., 1963), both pathogenic and non-pathogenic have been isolated from different parts of the diseased palms. Further, extensive root decay was observed in YLD affected palms (Rawther, 1976) and it was assumed that fungi were the causal agents of the disease. Based on these observations, a study to find out the role of fungi in causing the disease was carried out. But these fungi failed to reproduce YLD symptoms when inoculated to healthy potted areca seedlings (Anon., 1977). The study did not indicate any correlation between root decay and disease symptoms (Anon., 1977). No qualitative difference was noticed in the fungal flora of healthy and diseased palms (Anon., 1985).

Bacteria : Inoculation studies conducted with phytopathogenic bacteria isolated from disease-affected leaves, roots and rhizosphere failed to confirm their role in disease development.

Nematodes : The presence of nematodes within the diseased palms was first reported by Nair (1964). However, he could not correlate the population density of the nematodes with the incidence/intensity of the disease. Twenty two genera of plant parasitic nematodes were recorded from the root zone of the diseased areca palm (Koshy *et al.*, 1976). These nematodes, on inoculation of the potted seedlings, resulted in reduced growth, poor root formation and rotting and blackening

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of root tips, but did not induce the symptoms of YLD (Anon., 1988).

Virus and Mycoplasma : Menon (1960) observed some forms of protein and their sub- units in the sap of the disease affected areca palms. Later, studies with electron microscope ruled out the virus/viroid etiology. Nayar (1971) cultured Mycoplasma Like Organisms (MLOs) from leaf tissues of diseased palms and was later confirmed by electron microscopy (Nayar and Seliskar, 1978). The association of phytoplasma, hitherto called as mycoplasma, which is a phloem bound mollicute in YLD is established as evidenced by the reproduction of symptoms on young areca seedlings by transmission tests using dodder laurel (*Cassiytha filiformis*) and the plant hopper *Proutista moesta*. (Ponnamma et al., 1997). The diseased palms treated with tetracycline hydrochloride showed remission of symptoms while plants treated with penicillin and distilled water deteriorated further providing an additional supporting evidence for the phytoplasmal etiology (Anon., 1994). Electron Microscopic studies with stained tissues of sub-meristem, petiole of developing leaves rachilla of juvenile inflorescence, mature leaves and tender roots collected from diseased palms revealed the presence of phytoplasma in sieve tubes and same was not observed in the healthy palm. Samples for these studies were collected from Koppa, Sagar, Sringeri and Sullia also (Anon., 1991).

Physiology

The diseased palms exhibited reduction in photosynthetic efficiency, altered metabolism, elevated diffusive resistance, lower transpiration, higher water and turgor potential (Anon., 1989), high leaf sap capacity, total phenols, solids, tannin and dehydrogenase activity (Anon., 1962). Diseased leaf tissues exhibited low moisture content (59.1%) as against healthy (70.8%). The presence of low Mg in diseased tissues is reported and it is attributed to high CaO/MgO ratio (Anon., 1967). Higher stomatal resistance and lower transpiration and photosynthesis were observed in diseased areca palms (Chowdappa *et al.*, 1995). Higher Leaf water potential and turgor pressure and lower osmotic potential in diseased leaves shows that the disease leads to stomatal closure independent of water deficit (Chowdappa, *et al.*, 1993).

Biochemical aspects

Initial studies gave strong indications for the presence of nucleoproteins in diseased areca leaves (Menon, 1961). Accumulation of amino acids (cystine, aspartic acid and threonine) and progressive increase in lysine and argenine in advanced stage of disease is recorded (Nair, 1969). Some of the amino acids decreased with increase in disease or totally disappeared from the root on infection which indicated an impaired amino acid metabolism in diseased palms.

Varietal reaction

Work on this line in containing the disease was started in 1960s. All the indigenous and exotic accessions and hybrids tested under field condition for their resistance/tolerance to YLD showed typical YLD symptoms (Anon., 1970; Anon., 1984). The cross Siagon X Mangala showed higher yield with minimum disease intensity (Anon., 1990). However as it stands today there is no variety resistant/tolerant to YLD.

Soil nutrient status

Nitrogen and phosphorus deficiency in the soils of disease affected gardens was the first report on nutritional aspects of this malady. The soil samples collected from the diseased areas of Kerala showed low pH of about 3.8 and were deficient in all the three major nutrients (Anon., 1960, 1961, 1962). Velappan (1969) also observed low pH, organic carbon, available phosphorous and magnesium in the soils of yellow leaf disease affected gardens. Leaves of diseased palms contained lower amount of nitrogen, phosphorus, magnesium and zinc. Toxicity symptoms developed due to the application of manganese, calcium, boron and zinc did not resemble those of YLD symptoms. Pot culture studies conducted at Palode to investigate the role of major nutrient deficiencies in the development of the disease did not produce any symptoms typical of YLD (Yadav *et al.*, 1972). Leaf analysis of diseased palms at Vittal since 1969 revealed that leaf samples contained more than three ppm of dilute acetic acid extractable aluminium, a level, which is considered as dangerous to plants. Similarly, soil in diseased tracts recorded higher contents of exchangeable aluminium (Table 1) (Mohapatra *et al.*, 1976). Though the diseased soil contained higher amount of Fe and alumina (Anon, 1969, 1970, 1973; Mohapatra *et al.*, 1976), root feeding of Fe and alumina did not produce typical YLD symptoms (Anon., 1962, 1965) and had no effect on diseased palms (Anon., 1967) indicating non-involvement of these elements in YLD of areca. Though deficiency of other micronutrients like Cu, Mo, Zn etc., were recorded, their role in the symptom production could not be confirmed (Anon., 1962; Velappan, 1969).

Water logging

It is considered to be one of the predisposing factors in the incidence of the yellow leaf disease (Anon., 1960). It was reported that water table within the root

Table.1. Mechanical and fertility constituents of soils from yellow leaf disease affected and healthy areas of Kerala and Karnataka states.

Constituents	Kerala State				Karnataka State			
	Apparently healthy		Diseased		Healthy		Diseased	
	Low lying	High elevation	Low lying	High elevation	Low lying	High elevation	Low lying	High elevation
Sand(%)	72.48	62.60	69.92	65.91	59.68	55.84	56.77	58.45
Silt(%)	8.42	8.92	8.87	8.39	15.52	16.85	16.22	17.60
Clay(%)	19.08	26.34	21.20	25.68	24.79	27.29	27.26	23.80
pH(H_2O)	5.66	5.60	5.58	5.58	6.34	6.36	6.54	6.14
pH(KCl)	4.39	4.27	4.31	4.26	5.13	5.16	5.30	5.06
Organic carbon(%)	0.82	0.91	0.84	0.96	1.27	1.34	1.38	1.10
Av.P2O5 (ppm)	12.17	6.06	9.23	6.01	21.46	14.84	18.95	9.05
Av.K2O(ppm)	66.52	84.00	75.81	84.90	144.10	163.18	153.18	130.80
Ex. Ca(ppm)	179.5	215	186.2	185.40	692.90	720.30	834.00	497.50
Ex.Mg(ppm)	47.90	68.80	45.20	59.00	173.10	190.90	220.10	152.40
Ex.Al(ppm)	54.35	64.53	59.95	68.84	1.59	0.10	0.45	Traces
Extractable Al(ppm)	66.97	97.48	83.30	105.60	41.21	42.10	48.23	37.84
$Fe^{2+}Fe^{3+}$ (ppm)	19.53	14.77	23.98	16.16	14.83	12.80	12.90	12.36
Ex.Mn(ppm)	8.03	8.83	7.65	8.82	12.50	17.47	15.68	16.30
Dithizone extractable Zn(ppm)	1.03	1.08	1.15	0.98	2.32	2.36	2.49	2.22
Ex. Cu(ppm)	2.04	1.92	1.99	1.97	3.94	4.02	3.57	3.32

Source : Mohapatra *et al.*, 1976.

zone of palm in the disease- affected garden leads to reduced condition during rainy season. Studies on the effect of submergence on soil pH and exchangeable aluminium indicated that there was increase in pH from 5.01 to 6.08 during the first 15 days of submergence and subsequently, continuous submergence up to 90 days led to considerable decrease in pH (4.27) (Anon., 1969). The exchangeable aluminium was inversely related to changes in soil pH.

Disease management

As the disease is not amenable to any chemical control method, the only way out to get good yield is to resort to better management of the garden. Experiments conducted at CPCRI over the years regarding the nutrient application have revealed that application of 1 kg super phosphate has delayed the symptom expression in areca seedlings and application of additional dose of P_2O_5 over the normal dose has increased the yield (Anon., 1990). Further, it was observed that plants receiving NPK + Dolomite + neem cake showed reduced disease intensity. It was also noticed that Mg application has beneficial effect in containing the disease. Experimental results have also shown that application of recommended dose of NPK along with zinc or boron and manganese also could reduce the symptoms.

Present line of work at CPCRI

Looking into the gravity of YLD problem in different parts of the areca growing areas, CPCRI planned YLD management and breeding for resistance/tolerance trials in different YLD affected areas. A total of 6 management trials were laid out in Karnataka (2 in Sullia/ Sampaje - DK; 3 in Sringeri - Chikamagalore) and Kerala. The treatments for the trials were decided based on the earlier studies conducted in this line. Experiments are also being conducted to find out resistant/tolerant lines using hybrid combinations and also seedlings raised from the elite palms identified in diseased areas. For this purpose, the elite palms were selected from the disease affected areas of Karnataka and Kerala.

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